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ON CERTAIN ASPECTS OF THE LOESS¹ OF SOUTH-WESTERN IOWA.

RECENTLY the Chicago, Burlington & Quincy Railroad has made some extensive cuttings on a new right of way in southwestern Iowa, affording thereby excellent opportunities for observations on the loess and the underlying till. These cuts are especially interesting on account of the varied aspects presented by the surface material overlying the glacial drift. Three sheets of loess in the same vertical section are discernible.

First, or uppermost, is the ordinary yellow deposit of the Missouri bluffs phase common at the surface everywhere throughout the region, and which needs no further description.

Underlying this loess is a loess of different character; it is whitish in color, and is more clay-like in texture than the ordinary deposit. It appears also to contain less calcareous matter. The white loess and the yellow loess are distinguishable, not merely in fresh section by their difference in color and texture, but also in weathered exposures by their different aspects. The yellow loess tends to assume that peculiar facies familiar to all who have seen the western phase of the loess, whereas the white loess displays more of the behavior of a joint clay, especially as regards superficial drying and cracking.

Below the white loess and in marked contrast with it in the matter of color is a red loess. This red loess occasionally contains a few calcareous nodules of the general appearance of loess kindchen; its lowermost six inches contain pebbles of various sorts, but these rarely exceed the size of a bean and are absent from the upper part of the deposit, as they also are from the white and the yellow loess. In texture the red loess resembles somewhat the white loess above it; it is apparently a little less clayey.

¹ It may not be out of place to remark that there seems to be a tendency to give the word "loess" a specific meaning rather than to assign to it a generic significance, which would be more desirable. To the writer loess means any considerable accumulation of surface material, eolian in origin, the component particles of which are too small to give the deposit the character of sand or grit. Subject to this limitation, loess may have any texture or any color, as well as any peculiarity of topographic facies.

Underneath the red loess is the pebbly till of the Kansan drift-sheet, which is here of the same general character as that everywhere seen throughout southern Iowa. It is the usual rock meal charged with erratics of every description; the uppermost three or four feet present the usual aspects of the ferretto zone so well described by the geologists of the Iowa survey. The color of this ferretto approximates closely that of the red loess above it, but there is never the slightest difficulty in distinguishing the line of demarkation. The leaching

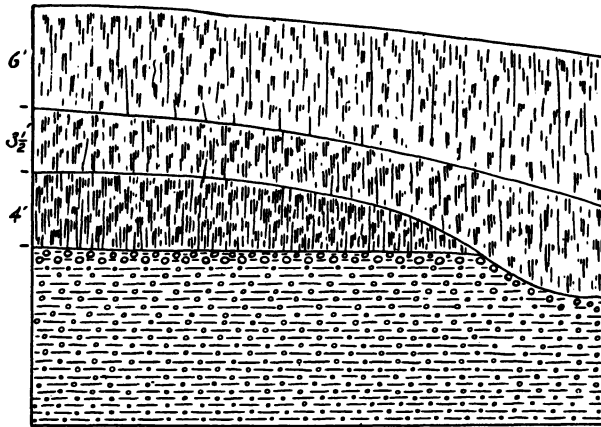


FIG. 1.—Section in railroad cut at Red Oak, Iowa, showing the three deposits of loess over the Kansan till.

and oxidation which produced the ferretto have left it mottled with white patches of kaolin, marking the site of former pebbles of feldspar. It contains also numerous pebbles of quartzite, greenstone, and other materials. Moreover, the exact line of demarkation is very frequently indicated by a layer of gravel and pebbles which owes its origin to the action of wind and weather on the long-exposed surface of the till, whereby the finer particles were removed and the coarser ones left behind as a mechanical concentrate. This phenomenon is similar to that observed at the contact of the upper surface of the Iowan drift with the loess in the paha region of the eastern part of the state.

As shown in the railroad cuts within the city limits of Red Oak,

the yellow loess, is, at a maximum, about twelve feet in thickness, the white loess about six, and the red about four or five. Westward of Red Oak both the red and the yellow loess increase in thickness relatively to the white loess, which finally disappears in this direction. The yellow loess then rests directly on the red loess. To the eastward of Red Oak the reverse is true; the yellow and the red both decrease in thickness. In a sixty-foot cut two miles east of Red Oak the red loess is wanting; the white loess, eight feet in thickness, rests directly on the ferretto. Near the Adams county line the yellow loess appears to be very much reduced. East of Corning the surface loess resembles the white loess and may be identical with it; the resemblance here imputed refers both to fresh and weathered sections.

The most favorable place for studying these deposits and the relations between them are: in the cut just east of the depot at Red Oak, south of the depot in the bluffs left in excavations made by the railroad for material for fills, and in the cuts on the divide between the East Nishnabotna River and Walnut Creek.

As regards the propriety of designating the white and red deposits herein described as loess, there can be little question. They are deposits of loess for practically the same reasons that have been urged in the case of the yellow loess, the eolian origin of which has now been conceded by most geologists. Like the yellow loess, they conform, blanket fashion, to the inequalities of the pre-loessial topography; like the yellow loess, they are invariably thickest on the crests and brows of the erosional hills carved out of the old Kansan drift-plain. They are not to be considered as of subaqueous origin for the reason that no conclusive evidence has been obtained that the region in which they are found was ever submerged beneath such a large body of water as would have been a condition necessary to their deposition.

The red loess is evidently no mere local deposit. It has been observed in Pottawattamie county, which lies north of Montgomery county, by Udden,¹ who describes it under the name of "gumbo."

¹ *Iowa Geological Survey*, Vol. XI, p. 255. The writer has examined the red deposit described by Udden as occurring under the yellow loess at Minden, and has satisfied himself of its loessial nature as herein defined. It may be remarked that the name "gumbo," as applied to the red loess, is apt to prove a confusing misuse of a

The reddish-yellow loess reported¹ by Udden from Mills county is probably a modification of the red loess; the ferruginous, weather-stained loess reported by Calvin² as occurring in Page county under the yellow loess, and separated from it by a layer of cross-bedded eolian sand, can scarcely be anything else. The white loess will probably be found to have a wide distribution; it, or a loess very much like it, is to be found under the yellow loess in Carroll county.³ Bain and Tilton⁴ have casually mentioned the occurrence of two sheets of loess at different points in southern Iowa. One of these is probably the white loess. The white loess is also reported from Pottawattamie county by Udden, who, however, thought it to be a modification of his gumbo. As the width of the area of overlap of these two sheets of loess appears to be rather limited, Udden probably did not see them in the same vertical section, and hence his failure to recognize them as distinct deposits would be accounted for. A very interesting suggestion is contained in the fact noted above, namely, that the red loess does not seem to extend far to the east of Red Oak, while the white loess apparently thins out to the west of the same place. The suggestion is that a deposit of loess may have fairly definite boundaries, which may be imposed on it by vegetation in much the same way as vegetation imposes limits to the spread of the drifting sand of a dune area.

The red, the white, and the yellow loess are not different phases of one original loess which has undergone secondary modification since its deposition. A view affirming the contrary would be negatived by the reflection that changes produced by weathering or interstitial deposition of material by infiltration would not be likely to simulate

term borrowed from agricultural terminology. "Gumbo" properly means a stiff, impervious, waxy, clay-silt, which the red loess certainly is not. It is an open question whether the red loess was deposited as such, or acquired its red color through subsequent oxidation of its iron content. On the other hand, there exists the possibility that it consists of the finer particles sorted out of the red ferretto and carried by the wind to new resting-places. It would therefore be local in origin; the other loesses are, however, clearly foreign.

¹ *Ibid.*, Vol. XII, p. 167.

² *Ibid.*, Vol. XIII, p. 445.

³ Verbal communication from Professor B. Shimek, and later verified by personal inspection. Both sheets of loess are well shown in the railroad cuts southwest of Carroll.

⁴ *Op. cit.*, Vol. VII, p. 523.

ordinary bedding over wide areas. Conclusive evidence that each is a deposit *sui generis* is also afforded by their stratigraphic relations; all three deposits must be regarded as unconformable the one with the other as well as with the till. This is beautifully shown as regards the red and the white loess in the cut just east of the depot at Red Oak, where it may be seen that the red loess has been involved in erosion antedating the white loess, which fills a depression previously cut through the red loess into the till. Analogous evidences of a stratigraphic break between the white and the yellow loess are not wanting in the same neighborhood. In this connection the red loess observed by Calvin in Page county may again be referred to. The layer of eolian sand there separating the red loess from the yellow loess is additional, if slight, evidence of the time break between the two deposits.

The inferences to be drawn from the existence of these three sheets of loess and from their mutual relations are extremely interesting. Considered along with the cursory references of various geologists to the existence of distinct loess sheets in southern Iowa, it would appear that the real complexity of the loess can no longer be doubted; "the problem of the loess" becomes, in a new sense, one of magnitude and importance. Here, as elsewhere in geology, a stratigraphic break is a fact of prime significance. The deeply scored surface of the Kansan drift is clear evidence of a long period of time before new conditions brought on the red loess; the supercession of red loess deposition by an interval of erosion, followed by a period which witnessed the deposition of a new and different loess, is sufficient evidence that the interloessial period was long enough to bring about fundamental changes in governing geological conditions. The change from the white to the yellow loess has the same significance.

It may be permissible to remark that the development of our knowledge of the loess is perhaps now in about the same stage as was our knowledge of glacial drift just after its glacial origin had been established. At first geologists could see only one drift-sheet and did not dream of more than one ice-invasion. It was only after the complexity of the glacial deposits had been perceived that they were forced to those studies which have given us our present theories of glacia-

tion. It remains to be seen whether a general recognition of the complexity of the loess is to be followed by a satisfactory explanation of the loessial and interloessial stages. Iowa, which has become classic ground for the glaciologists, will undoubtedly afford much illuminating material to the students of the loess.

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